CLAIMS

1. An avalanche photodiode comprising:

a stacked layer body in which an n-type electrode layer, an avalanche multiplication layer, an electric field control layer, a graded bandgap layer, a light absorbing layer with a layer thickness of W_A, and a p-type electrode layer are stacked sequentially,

the light absorbing layer has a junction of a p-type layer with a layer thickness of W_{AN} located on the side of the p-type electrode layer and a low concentration layer with a layer thickness of W_{AD} located on the side of the graded bandgap inclined layer ,

an each doping profile of the p-type and the low concentration layers is determined under device operating conditions so that a p-type neutral state is maintained for the p-type layer except a region in a vicinity of an interface of the junction with the low concentration layer while the low concentration layer is depleted, and

a ratio between the layer thickness W_{AN} of the p-type layer and the layer thickness W_{AD} of the low concentration layer is determined so as to satisfy a next formula in a case where t_{total} is a delay time of element response accompanying a transit of carriers generated in the light absorbing layer by light absorption, t_{N2} is a delay time caused by the p-type layer, t_{D1} is a delay time caused by the low concentration layer, and t_D is a delay time when

an entire region of the light absorbing layer is the low concentration layer, under a condition that a layer thickness W_A (= W_{AN} + W_{AD}) of the light absorbing layer is constant.

[Formula 1]

$$t_D > t_{total} = (W_{AD} \times t_{D1} + W_{AN} \times t_{N2}) / W_A$$

2. The avalanche photodiode according to claim 1, wherein the ratio between the layer thickness W_{AN} of the p-type layer and the layer thickness W_{AD} of the low concentration layer is determined so that a formula [(W_{AD} × t_{D1} + W_{AN} × t_{N2}) / W_A] takes on a local minimum.

3. The avalanche photodiode according to claim 1, wherein the p-type layer and the low concentration layer are formed of an InGaAsP mixed crystal semiconductor, and a depletion thickness of the low concentration layer during the device operation is thicker than 0.3 μm (W_{AD} > 0.3 μm).